CLAIMS

1. A hybrid arched overfilled bridge structure comprising:

A) an overall arc length;

B) an overall running length;

C) a plurality of arcuate pre-cast side elements, each side element including

(1) a running length extending in the direction of said overall running length and being smaller than said overall running length, and

(2) an arc length extending in the direction of said overall arc length and being smaller than said overall arc length; and

D) an arcuate cast-in-place crown sector element connecting two side elements together and which includes

(1) a running length extending in the direction of said overall running length and being smaller than said overall running length, and

(2) an arc length extending in the direction of said overall arc length and being smaller than said overall arc length.

2. The hybrid arched overfilled bridge structure defined in Claim 1 further including a plurality of cast-in-place crown sector elements, each having a running length smaller than said overall running length.

3. The hybrid arched overfilled bridge structure defined in Claim 2 wherein the running length of each crown sector element is at least equal to the running length of each side element.

4. The hybrid arched overfilled bridge structure defined in Claim 2 further including joints between adjacent crown sector elements.

5. The hybrid arched overfilled bridge structure defined in Claim 1 further including ends on said overall running length and an end treatment at each end of said overall running length.

6. The hybrid arched overfilled bridge structure defined in Claim 1 wherein each side element has a tangential angle such that a gradient of no more than about 20^0 to 30^0 is established when the side element is laid flat.

7. The hybrid arched overfilled bridge structure defined in Claim 1 wherein each side element has a tangential angle such that a gradient of more than 30^0 is established when the side element is laid flat.

8. The hybrid arched overfilled bridge structure defined in Claim 1 wherein each side element includes a connecting element that protrudes into said cast-in-place crown sector element to connect the side element to said cast-in-place crown sector element.

9. The hybrid arched overfilled bridge structure defined in Claim 1 further including waterproofing elements on said crown sector element.

10. The hybrid arched overfilled bridge structure defined in Claim 2 wherein said plurality of cast-in-place crown sector elements form a continuous structure along said overall running length.

11. The hybrid arched overfilled bridge structure defined in Claim 5 wherein said end treatment includes a spandrel wall.

12. The hybrid arched overfilled bridge structure defined in Claim 1 further including steel reinforcement elements in said cast-in-place crown sector element.

13. The hybrid arched overfilled bridge structure defined in Claim 1 further including a footing structure.

14. The hybrid arched overfilled bridge structure defined in Claim 5 wherein said end treatment includes a wing wall.

15. The hybrid arched overfilled bridge structure defined in Claim 5 wherein said end treatment includes a battered slope to which the end of the structure conforms.

16. A hybrid arched overfilled bridge structure comprising:

A) an overall width dimension measured from a first side edge of a first pathway to a second side edge of the first pathway in a set up configuration with the first pathway having a lengthwise dimension extending in the direction of

the first and second side edges, the first pathway including a centerline located midway between the first and second side edges of the first pathway and extending along the lengthwise direction of the first pathway, a first plane containing a portion of the lengthwise dimension of the first pathway;

B) a running length dimension measured along the lengthwise dimension of the first pathway;

C) an overall height dimension in the set-up configuration measured from the first plane in the first pathway to a second plane adjacent to a second pathway with the second plane in the second pathway being spaced apart from the first plane in the first pathway, said overall height dimension including a maximum overall height dimension;

D) a widthwise shape that is arcuate in the set-up configuration and has a radius of curvature extending from the first pathway toward the second pathway in the set-up configuration and an overall arc length in the set-up configuration corresponding to the radius of curvature, said overall width dimension and said overall height dimension;

E) first and second end treatments, with each end treatment located adjacent to an end of said running length dimension in the set-up configuration;

F) first and second footing strips, each footing strip located adjacent to the first and second side edges of the first pathway respectively in the set-up configuration, each footing strip including

(1) two ends,

(2) a length dimension extending between the two ends of each footing strip,

(3) first and second sides extending along the length dimension of each footing strip,

(4) a top surface, and

(5) a channel defined in the top surface of each footing strip in the set-up configuration and extending along the length dimension of each footing strip;

G) a plurality of side elements, each side element including

(1) an arcuate body,

(2) a first end on the body of each side element which is received in one of the channels in the set-up configuration,

(3) a second end on the body of each side element which is spaced from the first end of the body of each side element with the arcuate body of each side element in the set-up configuration extending from the channel which receives the first end of the side element toward the second plane in the second pathway whereby the second end of each side element in the set-up configuration is located between the channel receiving the first end of each side element and the second pathway,

(4) a radius of curvature of the body of each side element,

(5) a side element arc length which corresponds to the radius of curvature of the body of each side element and extends from the first end on the body of each side element to the second end on the body of each side element,

(6) the arc length of the body of each side element in the

set-up configuration being smaller than said overall arc length,

(7) two sides which are spaced apart from each other along said running length dimension in the set-up configuration,

(8) a length dimension of the body of each side element measured between the two sides of the body of each side element along said running length dimension in the set-up configuration,

(9) the length dimension of the body of each side element being smaller than said overall length dimension,

(10) a connecting element on the second end of the body of each side element and extending away from the second end of the body of each side element,

(11) each side element of said plurality of side elements being pre-cast before being placed in the set-up configuration; and

H) a plurality of crown sector elements, each crown sector element including

(1) an arcuate body,

(2) a first end on the body of each crown sector element which is oriented to extend along said running length dimension in the set-up configuration,

(3) a second end on the body of each crown sector element which is spaced from the first end of the body of each crown sector element,

(4) a radius of curvature of the body of each crown sector element,

(5) a crown sector element arc length which corresponds to the radius of curvature of the body of each crown sector element

and extends from the first end of the body of each crown sector element to the second end of the body of each crown sector element in the set-up configuration,

(6) the crown sector arc length of the body of each crown sector element being smaller than said overall arc length,

(7) two sides of the body of each crown sector element which are spaced apart from each other along said running length dimension the set-up configuration,

(8) a length dimension of the body of each crown sector element measured between the two sides of the body of each crown sector element,

(9) the length dimension of the body of each crown sector element being smaller than said overall length dimension,

(10) the length dimension of the body of each crown sector element being at least equal to the length dimension of the body of each side element, and

(11) each crown sector element of said plurality of crown sector element being cast-in-place after at least some of said side elements have been placed in the set-up configuration.

17. The hybrid arched overfilled bridge structure defined in Claim 16 wherein the first end of the body of each crown sector element abuts the second end of the body of one side element and the second end of the body of each crown sector element abuts the second end of the body of a second side element and the connecting element on the second side of the first and second side elements protrude into one of said

plurality of cast-in-place crown sector elements in the set-up configuration.

18. The hybrid arched overfilled bridge structure defined in Claim 17 wherein the arcuate body of each crown sector element has a tangential angle such that a gradient of no more than about 20^0 to 30^0 is established

19. The hybrid arched overfilled bridge structure defined in Claim 17 wherein the arcuate body of each crown sector element has a tangential angle such that a gradient of more than 30^0 is established.

20. The hybrid arched overfilled bridge structure defined in Claim 16 further including crown sector cold joints.

21. The hybrid arched overfilled bridge structure defined in Claim 19 further including crown sector shrinkage joints.

22. The hybrid arched overfilled bridge structure defined in Claim 16 wherein a side element includes heating elements.

23. The hybrid arched overfilled bridge structure defined in Claim 22 wherein a crown sector element includes heating elements.

24. The hybrid arched overfilled bridge structure defined in

Claim 16 wherein each crown sector element further includes reinforcing elements.

25. A method of forming a hybrid arched overfilled bridge structure comprising:

A) defining a first pathway;

B) defining a second pathway spaced above said first pathway;

C) providing a plurality of pre-cast side elements;

D) erecting the pre-cast side elements in two rows along the first pathway to extend toward the second pathway and partially over the first pathway; and

E) casting in place a crown sector element between two pre-cast side elements to extend from one pre-cast side element of the two pre-cast side elements to the other side element of the two pre-cast side elements so the cast-in-place crown sector combines with the two pre-cast side elements to define a bridge over the first pathway.

26. The method of forming a hybrid arched overfilled bridge structure defined in Claim 25 further including providing a casting table for the production of side elements having an arcuate form surface and an adjustable end and a connection element on another end, moving the adjustable end, and pouring concrete mix onto the form surface of the casting table to form an arcuate pre-cast side element.

27. The method of forming a hybrid arched overfilled bridge

structure defined in Claim 25 further including providing a casting table having an arcuate form surface and pouring concrete mix onto the form surface of the casting table to form an arcuate pre-cast side element.

28. The method of forming a hybrid arched overfilled bridge structure defined in Claim 27 further including moving the form surface of the casting table.

29. The method of forming a hybrid arched overfilled bridge structure defined in Claim 25 further including using a crown sector form which has a form surface supported by a frame support located between the two pre-cast side elements and pouring concrete mix onto the crown sector form surface.

30. The method of forming a hybrid arched overfilled bridge structure defined in Claim 29 further including moving the crown sector form surface and the form associated therewith into a desired position.

31. The method of forming a hybrid arched overfilled bridge structure defined in Claim 30 wherein the step of moving the crown sector form surface and the form support associated therewith includes using hydraulic elements and wheels to move the crown sector form surface and form support.

32. The method of forming a hybrid arched overfilled bridge

structure defined in Claim 26 further including orienting the form surface of the casting table to define tangential angles of the arcuate pre-cast side element formed on the casting table, with the tangential angles such that a gradient of no more than about 20^0 to 30^0 is established

33. The method of forming a hybrid arched overfilled bridge structure defined in Claim 26 further including orienting the form surface of the casting table to define tangential angles of the arcuate pre-cast side element formed on the casting table, with the tangential angles such that a gradient of more than 30^0 is established.

34. The method of forming a hybrid arched overfilled bridge structure defined in Claim 29 further including sealing ends of the crown sector form surface.

35. The method of forming a hybrid arched overfilled bridge structure defined in Claim 26 further including vibrating the casting table.

36. The method of forming a hybrid arched overfilled bridge structure defined in Claim 35 further including compacting the concrete mix.

37. The method of forming a hybrid arched overfilled bridge structure defined in Claim 25 further including forming a

structural connection between the cast-in-place crown sector element and two side elements.

38. The method of forming a hybrid arched overfilled bridge structure defined in Claim 25 further including beveling edges at the crown sector element.

39. The method of forming a hybrid arched overfilled bridge structure defined in Claim 25 wherein the step of providing side elements includes forming pre-cast side elements in a horizontal orientation and the step of erecting the pre-cast side elements includes lifting the pre-cast side elements in place.

40. The method of forming a hybrid arched overfilled bridge structure defined in Claim 39 wherein the step of casting in place a crown sector element includes providing a purpose built traveling form and pouring a concrete mix onto the traveling form surface and form support.

41. The method of forming a hybrid arched overfilled bridge structure defined in Claim 39 wherein the step of casting in place a crown sector element includes forming shrinkage joints in the crown sector element.

42. The method of forming a hybrid arched overfilled bridge structure defined in Claim 40 further including supporting the pre-cast side elements against the traveling form surface prior

to pouring the concrete mix onto the form surface.

43. The method of forming a hybrid arched overfilled bridge structure defined in Claim 40 further including knocking down the traveling form after the crown sector has been formed and re-using the form.

44. The method of forming a hybrid arched overfilled bridge structure defined in Claim 28 wherein said step of moving the form surface of the casting table includes orienting the form surface at a first orientation to slope less than a castable concrete gradient, pouring part of the concrete mix, compacting the poured concrete mix, re-orienting the form surface into a second orientation and pouring another part of the concrete mix.

45. The method of forming a hybrid arched overfilled bridge structure defined in Claim 25 wherein said step of casting in place a crown sector element includes providing reinforcing elements and pouring concrete mix over the reinforcing elements.

46. The method of forming a hybrid arched overfilled bridge structure defined in Claim 45 further including waterproofing the side elements and the cast-in-place crown sector element.

47. The method of forming a hybrid arched overfilled bridge structure defined in Claim 46 further including backfilling.

48. The method of forming a hybrid arched overfilled bridge structure defined in Claim 26 further including heating the side elements while the concrete mix hardens.

49. The method of forming a hybrid arched overfilled bridge structure defined in Claim 48 further including heating the crown sector element after the crown sector element has been cast in place while the concrete mix hardens.

50. A method of forming a hybrid arched overfilled bridge structure comprising:

A) defining a first pathway;

B) defining a second pathway spaced above said first pathway;

C) forming a plurality of pre-cast side elements using a casting table;

D) adjusting the casting table during the formation of a side element;

E) providing each side element with a connecting element;

F) placing two footing strips adjacent to the first pathway, with one footing strip on each side of the first pathway;

G) supporting one end of each of the pre-cast side elements on one of the footing strips;

H) forming two rows of footing strips along the first pathway and orienting each pre-cast side element to extend from the footing strip toward the second pathway and partially over the first pathway with the connecting element extending over the first pathway;

I) placing a crown sector formwork on the footing strips;

J) adjusting the crown sector formwork;

K) supporting the pre-cast side elements against the formwork;

L) pouring a concrete mix onto the crown sector formwork and onto the connecting elements; and

M) casting in place a crown sector element on the formwork and between the two rows of pre-cast side elements to extend from one pre-cast side element in one row of the two rows of pre-cast side elements to a second pre-cast side element in a second row of the two rows of pre-cast side elements; and

N) locking the crown sector element to the side elements so the cast-in-place crown sector combines with the pre-cast side elements to define a structure over the first pathway.

51. A method of forming a hybrid arched overfilled bridge structure comprising:

A) defining a first pathway;

B) defining a second pathway spaced above said first pathway;

C) forming a plurality of arcuate pre-cast side elements using a casting table having an arcuate work surface;

D) heating a pre-cast side element while it hardens after pouring;

E) adjusting the casting table during the formation of a side element;

F) providing each side element with a connecting element;

G) placing two footing strips adjacent to the first pathway, with one footing strip on each side of the first pathway;

H) supporting one end of each of the pre-cast side elements on one of the footing strips;

I) forming two rows of footing strips along the first pathway and orienting each pre-cast side element to extend from the footing strip toward the second pathway and partially over the first pathway with the connecting element extending over the first pathway;

J) placing a crown sector formwork on the footing strips;

K) adjusting the crown sector formwork using mechanical elements;

L) providing reinforcing elements adjacent to the crown sector formwork;

M) sealing ends of the crown sector form;

N) supporting the pre-cast side elements against the formwork;

O) pouring a concrete mix onto the crown sector formwork and onto the connecting elements and onto the reinforcing elements;

P) casting in place a crown sector element on the formwork and between the two rows of pre-cast side elements to extend from one pre-cast side element in one row of the two rows of pre-cast side elements to a second pre-cast side element in a second row of the two rows of pre-cast side elements;

Q) heating the concrete mix on the crown sector form during curing;

R) locking the crown sector element to the side elements so the cast-in-place crown sector combines with the pre-cast side elements to define a bridge over the first pathway;

S) forming an end treatment at each end of the bridge; and

T) backfilling around the bridge.

52. In combination:

A) a casting table for forming a pre-cast side element for use in a hybrid arched bridge structure which includes a plurality of pre-cast side elements and a cast-in-place crown sector element;

B) a support;

C) an arcuate form surface on said casting table;

D) a first end on said form surface;

E) a second end mounted on said form surface.

53. The combination defined in Claim 52 wherein said second end is movable with respect to said form surface.

54. The combination defined in Claim 52 further including a pivot connecting said casting table form surface to said support.

55. The combination defined in Claim 52 wherein said arcuate form surface has an exterior angle of between 40^0 and 60^0.

56. The combination defined in Claim 52 wherein said arcuate form surface has an exterior angle of greater than 60^0.

57. In combination:

A) a form for forming a cast-in-place crown sector for use in a

hybrid arched bridge structure which includes a plurality of pre-cast side elements and a cast-in-place crown sector element;

B) a support section which includes movable legs;

C) an arcuate form surface;

D) ends on said form surface; and

E) seals on each of said ends.

58. The combination defined in Claim 57 wherein said movable legs include mechanical elements.

59. The combination defined in Claim 57 wherein said arcuate form surface has a tangential angle of between 40^0 and 60^0.

60. The combination defined in Claim 57 wherein said arcuate form surface has reinforced concrete thereon.

61. The combination defined in Claim 57 wherein said arcuate form surface includes truss falsework.

62. The combination defined in Claim 60 wherein said arcuate work surface further includes truss falsework.

63. The combination defined in Claim 57 further including cladding on said form surface.

64. The combination defined in Claim 63 wherein said cladding

includes insulation material.

65. In combination:

A) a form for forming a cast-in-place crown sector for use in a hybrid arched bridge structure which includes a plurality of pre-cast side elements and a cast-in-place crown sector element;

B) a support section;

C) an arcuate form surface;

D) ends on said form surface; and

E) seals on each of said ends.